Intolerance of Uncertainty and its Relation to Executive Working Memory

An Honors Thesis (PSYS 499)

by

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Abstract

Intolerance of uncertainty (IU) is demonstrated to have a negative association with working memory (WM), such that individuals with high levels of IU perform with less accuracy and longer response time (RT) on WM tasks. However, previous studies have only compared IU to responses from neutral stimuli in WM tasks. Given that IU is theoretically linked to increased responses to threat, it is important to consider emotional valence when measuring WM and its relation to IU. Thus, the goal of this study is to examine associations of IU and WM, specifically in reference to positive, negative, and neutral stimuli. It was hypothesized that a positive relation would be shown between IU, accuracy, RT, and negative verbal stimuli. Non-significant and weak correlations between IU, accuracy, and RT were hypothesized for both positive and neutral verbal stimuli. In this study, data was collected from 19 participants who provided survey responses concerning IU and then completed an emotional *n*-back task. Results indicated there were no statistically significant associations between scores on measures of IU and measures of accuracy and response time on *n*-back task (all p's > .05). The findings of this study, while not significant, challenge our understanding of the construct of IU while serving as a launching point for other areas of research.

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I would be remiss if I did not extend gratitude to my parents and friends, who were by my side every step of the way. Thank you for sharing many laughs, tears, and conversations while also pushing me to continue taking on this enormous task.

Process Analysis Statement

This thesis is the scientific method set in motion. As an aspiring clinical psychologist, I must be comfortable examining previous literature, formulating research questions, carrying out an experiment, and gathering conclusions about the results. I was able to take charge and really feel like this project was my own by running participants out of Ball State University's P.A.C.E. Lab. The ownership and pride I felt while doing this project has made every hiccup or obstacle worth it.

For this project, I initially intended to examine brain waves using EEG methodology, but the onset of a global pandemic hindered by ability to do so. Additionally, I had predicted I would have more participants in my study. Although I was unable to examine the brain waves for this project in order to make my argument stronger or garner more participants, I still feel I was able to acquire a great experience that will hopefully help me in my future endeavors in graduate school.

I believe this thesis may unveil more about the conceptualization of a construct called Intolerance of Uncertainty (IU). Not much is known about this construct in regards to emotionally-charged words, so being able to study that for this project may help future researchers. We are all in the midst of uncertain times, so understanding more about how we as humans experience uncertainty may help alleviate the tension we are feeling.

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PSYS 499: Department Honors in Psychology

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Abstract

Intolerance of uncertainty (IU) is demonstrated to have a negative association with working memory (WM), such that individuals with high levels of IU perform with less accuracy and longer response time (RT) on WM tasks. However, previous studies have only compared IU to responses from neutral stimuli in WM tasks. Given that IU is theoretically linked to increased responses to threat, it is important to consider emotional valence when measuring WM and its relation to IU. Thus, the goal of this study is to examine associations of IU and WM, specifically in reference to positive, negative, and neutral stimuli. It was hypothesized that a positive relation would be shown between IU, accuracy, RT, and negative verbal stimuli. Non-significant and weak correlations between IU, accuracy, and RT were hypothesized for both positive and neutral verbal stimuli. In this study, data was collected from 19 participants who provided survey responses concerning IU and then completed an emotional *n*-back task. Results indicated there were no statistically significant associations between scores on measures of IU and measures of accuracy and response time on *n*-back task (all p's $> .05$). The findings of this study, while not significant, challenge our understanding of the construct of IU while serving as a launching point for other areas of research.

Keywords: intolerance of uncertainty, working memory, emotional valence

Intolerance of Uncertainty and its Relation to Working Memory

Intolerance of uncertainty (IU) is considered to be a transdiagnostic factor contributing to internalizing disorders such as MDD and GAD. Buhr and Dugas (2009) define IU as "a dispositional characteristic that results from a set of negative beliefs about uncertainty and its implications and involves the tendency to react negatively on an emotional, cognitive, and behavioral level to uncertain situations and events" (p. 215). Intolerance of uncertainty can be divided into two separate facets: prospective IU and inhibitory IU (Buhr & Dugas, 2009). Prospective IU reflects a desire for predictability. This desire for predictability manifests as cognitive perceptions of threat pertaining to future uncertainty. For example, an individual may have the cognitive perception that he or she needs to be extremely organized in his or her life in order to avoid future disaster (Fetzner et al., 2013). Importantly, prospective IU is future oriented. This may be why research has shown that prospective IU is associated with trait anxiety, which is the core characteristic of GAD (Fetzner et al., 2013).

Inhibitory IU, the second facet of IU, is paralysis in the face of uncertainty (Buhr & Dugas, 2009). Typically, inhibitory IU leads to avoidance-oriented responses to uncertainty. Inhibitory IU is different from prospective IU because it is focused on the present moment. Specifically, an individual high on inhibitory IU may be unable to function effectively when faced with a current situation that produces uncertain results (Fetzner et al., 2013). For example, an individual may not be able to make a decision when faced with uncertainty, or procrastinate on making said decision. Researchers have found that inhibitory IU is related to depression (Fetzner et al., 2013). In sum, inhibitory IU is conceptualized as a behavioral response to uncertainty, while prospective IU is believed to be a cognitive response to uncertainty.

Working Memory

IU is thought to influence the types of information people pay attention to and how they respond to the environment (Bredemeier & Berenbaum, 2013). Specifically, individuals who have high levels of IU may have trouble disinhibiting negative thoughts about uncertainty (Bredemeier & Berenbaum, 2013). These difficulties disinhibiting negative thoughts may act as a load on working memory, further reducing the resources of the limited capacity working memory system.

Working memory (WM) is a limited capacity system and its function is to manipulate, store, and maintain new and old information during the completion of complex cognitive tasks (Baddeley, 1992). Baddeley's model of WM initially included three subcomponents: the central executive, the visuospatial sketchpad, and the phonological loop (1992). The central executive, sometimes referred to as executive working memory (EWM), is considered to be the command center, while the visuospatial sketchpad and the phonological loop are known as the "slave systems," or systems that are subordinate to the central executive (Baddeley, 1992). The central executive recruits, manipulates, retrieves, and stores information from both the visuospatial sketchpad and the phonological loop (Baddeley, 1992). The visuospatial sketchpad is known for visual image manipulation, and can help store two-dimensional and three-dimensional information that is encoded from verbal stimuli (Baddeley, 1992). The phonological loop is known for storing language-based information and is activated during a process called subvocalization, or the process of silently pronouncing words while reading (Baddeley, 1992). Like the visuospatial sketchpad, the phonological loop also has an active processing component and a passive processing component (Baddeley, 1992). Of these components, EWM is of the most relevance to the current study.

EWM and Intolerance of Uncertainty

Preliminary research suggests IU is related to EWM. Behaviorally, the accuracy of participant's responses has been observed to be less when accounting for IU. Lambrecq et al. (2013) found that IU interferes with the storage and processing of environmental information, and hypothesized that this interference contributes to the maintenance of uncertainty across time. Thus, Lambrecq et al. (2013) suggested that higher levels of IU with a neutral WM task correlate with less accurate responses. Additionally, Broome et al. (2007) utilized a bead task as a neutral measure of EWM. In this research, an experimental group demonstrated increased levels of IU as well as increased errors on the memory task, which is indicative of WM deficits. IU and increased EWM deficits were positively correlated (Broome et al., 2007).

Response time, or how fast an individual responds to stimuli, has also been used to measure EWM. However, research on response time and IU is limited. Lambrecq et al. (2013) also examined response time in the study mentioned previously, and found that there were no significant effects or interactions when accounting for IU. However, Ahmari et al. (2014) actually found increased response times throughout experimental trials on a neutral WM task, even with higher WM load trials. This finding suggests that delayed response times are not WM deficits. It is plausible to suggest that delayed response times may be influenced by an outside factor, like emotional valence of stimuli for example.

Although the research on association between IU and WM is not as clear as it could be, some conclusions can be drawn when examining the association between WM and constructs closely related to IU. Generalized anxiety disorder (GAD) and major depressive disorder (MDD) are two examples of these constructs. IU is considered to be a transdiagnostic factor contributing to both GAD and MDD. Prospective IU is associated with trait anxiety, which is the core characteristic of GAD, while inhibitory IU is related to depression (Fetzner et al., 2013). The associations of GAD and MDD symptoms with decreases in EWM have been demonstrated through behavioral tasks. Individuals with high levels of worry and those with a large number of GAD symptoms have been found to show lower levels of working memory when engaging in verbal worrying (Bredemeier & Berenbaum, 2013; Leigh & Hirsch, 2011). It is suggested that anxiety restrains working memory from disinhibiting worrisome thoughts, and subsequently diverting capacity cognitive resources away from working memory and towards worry. Levens and Gotlib (2010) found that depressed participants have stronger connections to sad or negative stimuli than controls. Additionally, Levens and Gotlib (2010) observed that depressed participants have difficulty sustaining engagement with positive stimuli, suggesting that executive control processes in WM in these participants are insensitive to positive stimuli. Because of the negative nature of these constructs and their relation to IU, I expected to see similar trends when examining IU and WM.

Problems with previous literature arise when examining the valence of stimuli used in the studies. Typically, EWM was studied using neutral stimuli (e.g., Broome et al., 2007; Bredemeier & Berenbaum, 2013; Lambrecq et al., 2013). However, this appears to be an ineffective way to measure the influence of IU on EWM. By Buhr and Dugas's (2009) definition, IU suggests that schemas would be more easily activated by negative information, as they refer to IU as a negative set of beliefs and reactions to uncertainty. Thus, people high in IU might attend more to negative stimuli and disregard neutral or positive stimuli in their environments. To accurately measure the association of IU and EWM, researchers need to study positive, negative, and neutral stimuli in order to assess whether IU truly impacts EWM. It is important to distinguish whether or not valence impacts this association, or if this association is only observed with neutral stimuli.

Current Study

The current study aimed to examine whether or not the relation between IU and EWM is influenced by the valence of stimuli. Based on previous work suggesting IU and EWM are related (e.g., Bredemeier & Berenbaum, 2013; Tallon et al., 2016), I expected that valence of stimuli could provide a more nuanced picture of this relation. Behavioral EWM was measured through response time and accuracy on a *n*-back task using negatively valenced verbal stimuli. More specifically, I also hypothesized that participants with higher levels of IU will respond more accurately on the *n*-back task when viewing negatively valenced verbal stimuli due to more attention being diverted towards negatively valenced stimuli. Examining the role of IU and its influence on EWM when accounting for valence of emotional stimuli is important because it could assist clinicians in better understanding who is vulnerable to EWM deficits and why these deficits are occurring. Clinicians may also be able to direct treatment focus toward IU symptoms in order to decrease EWM impairments.

Materials and Methods

The data collected for the current study is part of a larger study. A description of the larger study is available in Appendix A.

Participants

Participants for this study were recruited through the Psychological Science Department Participant Pool online. This pool of participants is composed of Ball State University students enrolled in an introductory psychology class, and is typically made up of primarily freshman and sophomore undergraduate students. In order to qualify for the study, participants in the participant pool were pre-screened and were required to: be at least 18 years of age, have corrected 20/20 vision, be able to read English words appearing on a computer screen, and be able to navigate a computer interface using a computer mouse and a computer keyboard. The pre-screening process consisted of a short survey to be taken online that collected demographic data, medical history, and medical diagnoses from participants. Demographic data refers to information relating to the age, sex, ethnicity, etc. Medical history refers to information relating to concussions, hospitalizations, etc. Medical diagnoses refer to information relating to neurological disorders, learning disorders, etc.

After completing the pre-screening survey, participants were then administered another set of online surveys as part of the larger study. This additional set of online surveys aimed to assess participants' standing on the distress liability. These surveys estimated distress liability through quantifiable measures of depressive symptoms, anxious symptoms, and hopelessness symptoms, which are all core components of this liability. Scores of high standing on the distress liability qualified participants for the laboratory portion of the study. (See Procedure section below for more information). Although participants' standings on the distress liability were of concern to the larger study and not particularly this study, high distress liability has been correlated with high levels of IU. Since the overall study was recruiting participants both high and low on the distress liability, it allowed for a wider range of individual standings on the distress liability, as well as a wider range of individual standings on IU levels.

Materials

Intolerance of Uncertainty Scale-Short Form. The Intolerance of Uncertainty Scale-Short Form (IUS-12; Carleton et al., 2007) is a 12 item self-report inventory developed to assess individuals' reactions to uncertainty, ambiguous events, and the future. The IUS-12 is a shortened version of the Intolerance of Uncertainty Scale (IU; Freeston et al., 1994). Previous research suggests IUS-12 scores have good concurrent validity, as they are related to the Beck

Anxiety Inventory (BAI; Beck et al., 1988) and the Beck Depression Inventory-II (BDI-II; Beck et al., 1996). The internal reliability coefficient is .95 while the test-retest reliability coefficient is .85 (Carleton et al., 2007). The IUS-12 was used to measure levels of IU in the sample.

Intolerance of Uncertainty Index. The Intolerance of Uncertainty Index (IUI; Gosselin et al., 2007) is a 45-item self-report questionnaire developed to measure not only intolerance of uncertainty, but the cognitive and behavioral manifestations of this intolerance. The IUI (Part A) demonstrates criterion validity to measures such as the Beck Depression Inventory-II and the State-Trait Anxiety Inventory, while the IUI (Part B) demonstrates excellent convergent validity through associations with scores on the BAI (Lauriola et al., 2018). Internal reliability coefficients range from .85 to .95 and test-retest reliability coefficients ranging from .66 to .76 after five weeks after initial assessment (Gosselin et al., 2007). The IUI was used to measure levels of IU in the sample.

Emotional Verbal 3-back Tasks. A 3-back task involves encoding and storing of each stimulus within the sequence of the task, as well as updating stored information with the presentation of a new stimulus (Gajewski et al., 2018). Previous research suggests 3-back tasks are especially useful for measuring EWM because they require multiple cognitive processes involved with EWM to be used in the tasks. Items that are not relevant must be inhibited and abandoned from EWM (Gajewski et al., 2018). Additionally, the maintaining and manipulating of information during the 3-back task requires simultaneous processing of both verbal and visuospatial domains, indicating that *n*-back tasks in general fall under domain-general executive attention (Wilhelm et al., 2013). In this verbal 3-back task, participants were presented with a word as a stimulus, and must respond "yes" if the word on the present screen is identical to the word presented three screens earlier or "no" if it was not presented three screens earlier. This study intended to measure EWM in response to emotionally valenced verbal stimuli. Thus, while the larger study used both verbal and visuospatial emotionally valenced 3-back tasks, the current study focused on response accuracy and response time for solely verbal stimuli.

Procedure

Participants completed a pre-screen questionnaire in order to gather demographic and medical information in addition to quantifiable measures of psychological distress symptoms. These quantifiable measures were obtained through the participants' responses to the BDI-II, the BAI, and the BHS. Participants were then categorized into groups based on ranges for low, medium, and high standing on the distress liability. For the larger study, participants who received a low or high standing on the distress liability were invited to participate in a laboratory session. Data from only those participants qualifying for the high standing group was used in the current study. High standing on the distress liability requires participants to score high, or severe, on either the BDI-II and/or the BAI, while also scoring moderate to high on the BHS.

Further, participants completed the IUS-12 and the IUI during the pre-screening process, though the results from both the IUS-12 and the IUI were used to test the current study's hypotheses. This was done in order to reduce participant fatigue in the laboratory session, which can affect the validity of the EEG recordings. Thus, the laboratory session only required participants to complete verbal and emotional visuospatial n-back tasks recorded through electroencephalography (EEG) and the MMPI-2-RF, which is a protected instrument that cannot be administered outside of a secure setting (Ben-Porath & Tellegen, 2008). Participants received 0.5 SONA credits for participating in the pre-screening procedures.

Analytic Overview

Descriptive statistics were obtained for IUI scores, IUS-12 scores, and response time on the *n*-back task for positive, negative, and neutral valenced words. These descriptive statistics included the mean, standard deviation, skewness values, and kurtosis values. Correlational analyses were used to examine relations among the variables. It was expected that IUI scores would be positively correlated with response time and accuracy on the *n*-back task for negatively valenced words. Correlational analyses for positive and neutral words were also conducted in order to ensure that the negative valence of the stimuli is influencing this association, not just the emotionality of the stimuli. It is expected that the correlations between IUI scores, response times, and accuracy will be similar for both positive and neutral stimuli, and that these correlations will be weaker than the correlations for negative stimuli.

Results

Descriptive Statistics

Table 1 provides a comprehensive summary of descriptive analyses for IU scales and behavioral data. As seen in the table, all the measures included in the analyses were normally distributed (i.e., skew < 2 and kurtosis < 7; Curran et al., 1996). Additionally, scores on the IUI and IUS-12 had adequate levels of internal consistency (i.e., alpha > .80; Cortina, 1993). Thus, all measures were considered appropriate for use in the proposed analyses.

Analysis of IU Scores and Response Time

It was expected that IU, as assessed by the IUI and the IUS-12, would be significantly and positively correlated with response time on the *n*-back task for negatively valenced words, and that IU would not be significantly correlated with positive and neutral words. To investigate the relationship between IU scores on the IUI and IUS-12 and response time on the *n*-back task, Pearson's correlation coefficients were computed for each category of emotional valence:

positive, neutral, and negative. There were no outliers or trials that were excluded, regardless of the participant answering correctly or incorrectly for that trial. The results for IUI and response time were not significant for positively valenced words ($r = .274$, $p > .05$), neutrally valenced words ($r = .331$, $p > .05$), or negatively valenced words ($r = .335$ $p > .05$). The results for the IUS-12 and response time were also not significant for positive ($r = -.062$, $p > .05$), neutral words ($r = .014$, $p > .05$), or negative words ($r = .009$, $p > .05$). This is not surprising as IUI and IUS-12 scores were highly correlated, $r = .89$, $p < .001$.

Analysis of IUI Scores and Accuracy

It was expected that IU, as assessed by the IUI and the IUS-12, would be significantly and positively correlated with accuracy on the *n*-back task for negatively valenced words, and that IU would not be significantly correlated with positive and neutral words. To investigate the relationship between IUI scores and accuracy on the *n*-back task, Pearson's correlation coefficients were computed for each category of emotional valence: positive, neutral, and negative. The results for IUI and accuracy were not significant for positively valenced words ($r = -.077$, $p > .05$), for neutrally valenced words ($r = -.162$, $p > .05$), or for negatively valenced words ($r = -.079$, $p > .05$). The results for the IUS-12 & accuracy were not significant for positive words ($r = -.197$, $p > .05$), neutral words ($r = -.266$, $p > .05$), or negative words ($r = -.250$, $p > .05$).

Discussion

Prior research has demonstrated that intolerance of uncertainty (IU) is related to working memory (WM) deficits (Bredemeier & Berenbaum, 2013; Tallon, Koerner, & Yang, 2016). However, previous literature has only examined this using neutral stimuli. The relevance of the emotional valence of stimuli may be an important factor in explaining these deficits. This is because IU has been shown to be related to internalizing disorders, such as Generalized Anxiety Disorder (GAD) and Major Depressive Disorder (MDD), which rely heavily on negative emotional schemas. These disorders are also related to WM deficits, and individuals with these disorders have been shown to attend more strongly to negative stimuli over neutral stimuli (Leigh & Hirsch, 2011; Levens & Gotlib, 2010).

Based on these ideas, the current study aimed to examine IU and WM deficits. Because of the association of IU and WM, as well as IU and GAD/MDD, it was hypothesized that individuals with higher levels of IU would perform better on a WM task with negative stimuli when compared to positive and neutral stimuli. This study measured WM using response time and accuracy on an *n*-back task, and increased response time and reduced accuracy would indicate WM deficits. It was hypothesized that an individual with high levels of IU would respond more accurately to negatively valenced verbal stimuli, but would also spend more time attending to these negatively valenced verbal stimuli thus increasing the response time for these negative stimuli.

Overall, results suggested response times and accuracy on a working memory task were not significantly associated with scores on measures of IU, regardless of valence of stimuli. Thus, neither of my hypotheses were supported. The findings from this study are inconsistent with past research. Specifically, past studies have shown that neutral stimuli were at least significantly correlated with IU and WM deficits (i.e., Lambrecq et al., 2013; Broome et al., 2007; Ahmari et al., 2014). Thus, it is likely that additional research is needed to continue developing our understanding of the association between IU and EWM.

Theoretically, if results of the current study are replicated, they may indicate that the construct of IU may not be enough to account for WM deficits on its own. It could be that WM deficits are a result of a different transdiagnostic construct or culmination of many different transdiagnostic constructs. To test this idea, researchers may want to examine different constructs like Repetitive Negative Thinking or Negative Problem Orientation while following the same methodology of this study to see if different results occur. If possible to do so in one study, it may be of interest to examine the influence of the combination of IU, Repetitive Negative Thinking, and Negative Problem Orientation on WM. Combining all of these constructs may demonstrate that it is the consummation of these constructs that account for WM deficits, not just one isolated construct.

It is important to note that the findings of the current study may also be a result of limitations of the study. Specifically, a primary limitation of this study is the small sample size, which was influenced by low enrollment in the participant pool and the onset of a global pandemic. This limitation is particularly problematic as it meant analyses were under-powered and that Type II Errors (i.e., saying there was no association when there really is) were more likely. If I had a larger sample size, the pattern of results may have led to different conclusions. Specifically, if I interpret only the magnitude of associations demonstrated in this study, there was a moderate association between response time (regardless of valence) and IU, but not accuracy and IU. This is consistent with past work that has demonstrated relations between response time and IU for neutral stimuli (i.e., Lambrecq et al., 2013; Broome et al., 2007; Ahmari et al., 2014). This would suggest, practically, a different conclusion than that I described for the null results, namely that emotional valence has no influence on the accuracy of responses to a WM task at all, but rather that response time is determinant of the influence of IU. As such, I recommend this study be redone in the future with a larger sample and focus on response time.

A second limitation of the current study was the imbalance in male and female participants. Specifically, the study predominantly consisted of female participants. This prevented me from comparing differences in sex. However, this may be an important difference to investigate because Robichaud (2000) discovered that women engage more in worrying and constructs associated with worrying, like IU for example. Thus, it could be of interest to future researchers to examine differences in WM deficits when accounting for levels of IU and gender. Specifically, the question would be, “does gender impact WM deficits when the individual has a high level of IU?” Analyzing these differences may also lead to a more well-rounded perception of this concept.

Although the current study did not yield significant results regarding emotional valence and its effect on IU and WM, it is important to recognize the implications of this research. A moderate association found in this study between IU and RT may indicate that IU levels are reflected by RT on a WM task. Furthermore, these results could potentially indicate that IU may be one of many transdiagnostic constructs that influence and diminish WM. Additionally, differences in sex were unable to be measured in the current study, but may have relevance to the development and maintenance of WM by IU. Further research must be done in order to fully understand the consequences of IU levels on WM.

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Table 1

Descriptive Statistics for IU Scales and Behavioral Variables (N = 19)

IU Scales	Mean	SD	Min	Max	Skew	Kurt.	α
1. IUI	122.26	39.82	60	193	-.04	-.48	.98
2. IUS-12	30.68	12.40	13	53	.29	-1.32	.95

Behavioral Variable	Mean	SD	Min	Max	Skew	Kurt.
1. PosVerbAcc	.80	.11	.58	.99	-.14	-.57
2. PosVerbRT	748.00	232.80	365.80	1098.80	.06	-1.07
3. NeutrVerbAcc	.79	.150	.511	.979	-.12	-1.18
4. NeutrVerbRT	754.30	261.50	363.80	1328.90	.54	-.016
5. NegVerbAcc	.811	.13	.48	.97	-.74	1.20
6. NegVerbRT	750.40	232.30	376.50	1169.70	.15	-.72

Note. SD = Standard Deviation; Min = Minimum Range Value; Max = Maximum Range Value; Kurt. = Kurtosis; IUI = Intolerance of Uncertainty Index; IUS-12 = Intolerance of Uncertainty Scale-Short Form; PosVerbAcc = Accuracy for Positive Verbal Stimuli; PosVerbRT = Response Time for Positive Verbal Stimuli; NeutrVerbAcc = Accuracy for Neutral Verbal Stimuli; NeutrVerbRT = Response Time for Neutral Verbal Stimuli; NegVerbAcc = Accuracy for Negative Verbal Stimuli; NegVerbRT = Response Time for Negative Verbal Stimuli.

Appendix A

Description of the Larger Study

The larger study will examine the role of rumination in distress dysfunctions, and will attempt to extend these findings into both verbal and visuospatial domains of emotional working memory. In order to be invited into the laboratory portion of the study, participants will be pre-screened to assess their standings on the distress liability through the BDI-II, the BAI, and the BHS. This pre-screening will also consist of administering the Repetitive Thinking Questionnaire (RTQ; McEvoy, Mahoney, & Moulds, 2010), the IUI, and the IUS-12, although these measures are not used as inclusion criteria for the intended studies. The RTQ, IUI, and IUS-12 will be used for moderation analyses upon completion of data collection. In the laboratory portion of the study, participants will complete the MMPI-2-RF, as well as complete both verbal and visuospatial variations of the 3-back task using emotionally valenced words. Electrophysiological responses to stimuli, using EEG methodology, will be recorded while participants complete the 3-back task. The current study was a subsidiary of a current graduate student's thesis which was already approved by the IRB. Below is a copy of the IRB approval for the graduate student’s thesis.

BALL STATE UNIVERSITY

Office of Research Integrity
Institutional Review Board (IRB)
2000 University Avenue
Muncie, IN 47306-0155
Phone: 765-285-5052
E-mail: orihelp@bsu.edu

DATE:	October 8, 2019
TO:	Joshua Grzywana
FROM:	Ball State University IRB
RE:	IRB protocol # 1496431-1
TITLE:	A Brain Study on the Links Between Emotions and Memories
SUBMISSION TYPE:	New Project
BOARD DECISION:	APPROVED
PROJECT STATUS:	ACTIVE
DECISION DATE:	October 8, 2019
REVIEW TYPE:	**Expedited:** This protocol had been determined by the board to meet the definition of minimal risk.

The Institutional Review Board has approved your New Project for the above protocol, effective on October 8, 2019. Your project falls into the Expedited Category indicated below. As such, there will be no further review of your protocol, and you are cleared to proceed with the procedures outlined in your protocol. As an expedited study, there is no requirement for continuing review. Your protocol will remain on file with the IRB as a matter of record. All research under this protocol must be conducted in accordance with the approved submission and in accordance with the principles of the Belmont Report.

Your project falls under the indicated Expedited Categories:

	Category 1: Clinical studies of drugs and medical devices
	Category 2: Collection of blood samples by Finger stick, Heel stick, Ear stick, or Venipuncture
	Category 3: Prospective collection of biological specimens for research purposes by noninvasive means
	Category 4: Collection of data through Non-Invasive Procedures Routinely Employed in Clinical Practice, excluding procedures involving Material (Data, Documents, Records, or Specimens) that have been collected, or will be collected solely for non-research purposes (such as medical treatment or diagnosis)
	Category 5: Research involving materials that have been collected or will be collected solely for non-research purposes.

	Category 6: Collection of Data from Voice, Video, Digital, or Image Recordings Made for Research Purposes
X	**Category 7:** Research on Individual or Group Characteristics or Behavior or Research Employing Survey, Interview Oral History, Focus Group, Program Evaluation, Human Factors, Evaluation, or Quality Assurance Methodologies
	Category 8: Continuing review of research previously approved by the convened IRB
	Category 9: Continuing review of research, not conducted under an investigational new drug application or investigational device exemption where categories 2-8 do not apply but the IRB has determined and documented at a convened meeting that the research involves no greater than minimal risk and not additional risks have been identified.

Categories where the IRB has decided to downgrade protocol to Expedited review:

	Category 1: Continuing review of research previously approved by the convened IRB, where research activities are limited to data analysis only.
	Category 2: Continuing review of research, not conducted under an investigational new drug application or investigational device exemption where categories two (2) through eight (8) research involves no greater than minimal risk and no additional risks have been identified.
	Category 3: Protocol modifications have resulted in the protocol becoming minimal risk and qualifying for Expedited review.

While your project does not require continuing review, it is the responsibility of the P.I. (and, if applicable, faculty supervisor) to inform the IRB if the procedures presented in this protocol are to be modified or if problems related to human research participants arise in connection with this project. Any of these notifications must be addressed in writing and submitted electronically to IRBNet (www.irbnet.org). Please reference your IRB protocol number 1496431-1 in any communication to the IRB regarding this project. Be sure to allow sufficient time for review and approval of requests for modification or continuation. If you have questions, please contact Grace Yoder at (765) 285-5034 or gmyoder@bsu.edu.

In the case of an adverse event and/or unanticipated problem, you will need to submit written documentation of the event to IRBNet under this protocol number and you will need to directly notify the Office of Research Integrity (http://www.bsu.edu/irb) **within 5 business days**. If you have questions, please contact Grace Yoder at (765) 285-5034 or gmyoder@bsu.edu.

Please note that all research records must be retained for a minimum of three years after the completion of the project or as required under Federal and/or State regulations (ex. HIPAA, FERPA, etc.). Additional requirements may apply.